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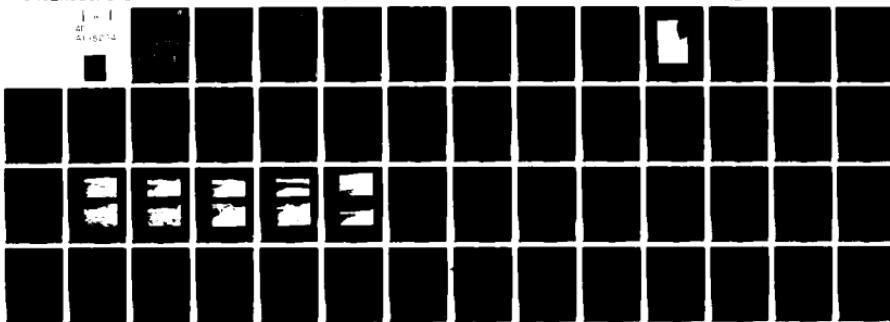
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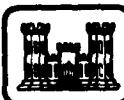
LOUTRE VALLEY DAM

MONTGOMERY COUNTY, MISSOURI

MO. 30083

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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LOUTRE VALLEY DAM
MONTGOMERY COUNTY, MISSOURI
MO. 30083

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR
GOVERNOR OF MISSOURI

JUNE, 1979

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

SUBJECT: Loutre Valley Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Loutre Valley Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood.
- 2) Overtopping could result in dam failure.
- 3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY SIGNED 13 MAR 1980
Chief, Engineering Division Date

APPROVED BY: SIGNED 13 MAR 1980
Colonel, CE, District Engineer Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

<u>PARAGRAPH NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
	Assessment Summary	
	Overview Photograph	
	SECTION 1 - PROJECT INFORMATION	
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	2
	SECTION 2 - ENGINEERING DATA	
2.1	Design	5
2.2	Construction	5
2.3	Operation	5
2.4	Evaluation	5
	SECTION 3 - VISUAL INSPECTION	
3.1	Findings	6
3.2	Evaluation	8
	SECTION 4 - OPERATIONAL PROCEDURES	
4.1	Procedures	9
4.2	Maintenance of Dam	9
4.3	Maintenance of Operating Facilities	9
4.4	Description of Any Warning System in Effect	9
4.5	Evaluation	9
	SECTION 5 - HYDRAULIC/HYDROLOGIC	
5.1	Evaluation of Features	10
	SECTION 6 - STRUCTURAL STABILITY	
6.1	Evaluation of Structural Stability	12
	SECTION 7 - ASSESSMENT/REMEDIAL MEASURES	
7.1	Dam Assessment	13
7.2	Remedial Measures	13

APPENDIX A - MAPS

Plate A-1 **Vicinity Topography**
Plate A-2 **Location Map**

APPENDIX B - PHOTOGRAPHS

Plate B-1	Photo Index	
Plate B-2	Photo No. 2	View Looking Upstream in Emergency Spillway
	Photo No. 3	View Looking Downstream in Emergency Spillway
Plate B-3	Photo No. 4	View of Upstream Slope from Right Abutment
	Photo No. 5	View of Downstream Slope from Right End
Plate B-4	Photo No. 6	Crest Taken from Right Abutment
	Photo No. 7	Principal Spillway Riser
Plate B-5	Photo No. 8	View Upstream from Station 3+30
	Photo No. 9	View Downstream from Station 3+30
Plate B-6	Photo No. 10	Outlet End of Principal Spillway
	Photo No. 11	Overview Taken from Upstream on Right Side

APPENDIX C - PROJECT PLATES

Plate C-1 Phase I - Plan and Centerline Profile of Dam
Plate C-2 Phase I - Section of Dam and Emergency Spillway Profile

APPENDIX D - HYDRAULIC AND HYDROLOGIC DATA

Plates D-1 & D-2	Hydrologic Computations
Plate D-3	Emergency Spillway Rating Curve
Plate D-4	Principal Spillway Rating Curve
Plate D-5	PMF Ratios - Peak Flow
Plates D-6 to D-18	Computer Input and Output for 1/2 PMF

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Loutre Valley Dam
State Located	Missouri
County Located	Montgomery County
Stream	Tributary Loutre River
Date of Inspection	June 27, 1979

Loutre Valley Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately one-half mile downstream of the dam. Within the damage zone are two dwellings, an outbuilding and Highway J.

Our inspection and evaluation indicate that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the amount of water impounded, the downstream hazards and the large flood plain of the Loutre River, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways will pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 20% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

No design data were available for this dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

Other than a few small trees and shrubs growing in the left downstream abutment trough and the lack of a trash rack on the inlet to the principal spillway, no other deficiencies were noted.

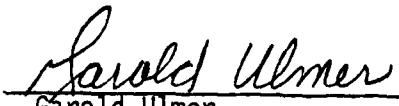
The maintenance of the dam is generally good. Items of preventative maintenance listed in the body of the report are addressed to removal of trees, prevention of tree growth and installation of a trash rack on the inlet to the principal spillway.



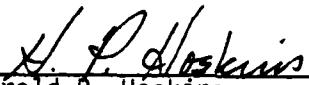
Rey S. Decker
E-3703



Gordon Jamison



Harold Ulmer
E-4777



Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696

PHOTO NO. 1 OVERVIEW.



PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LOUTRE VALLEY DAM - MO 30083
MONTGOMERY COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Loutre Valley Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances.
 - (1) The dam is an earth fill about 620 feet in length and 36 feet in height. It is located in moderately rolling hills with steep sided valleys.
 - (2) The principal spillway consists of a 24 inch steel riser with a 24 inch steel conduit passing through the embankment.
 - (3) A vegetated earth emergency spillway is cut through the right abutment.

(4) Pertinent physical data are given in paragraph 1.3 below.

- b. Location. The dam is located in the west central portion of Montgomery County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the W $\frac{1}{2}$ of Section 11, T47N, R6W. The lake formed behind the dam is shown in the W $\frac{1}{2}$ of Section 11, T47N, R6W.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the small size category.
- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on these guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately one-half mile downstream of the dam. Within the damage zone are two dwellings, an outbuilding and Highway J.
- e. Ownership. The dam is owned by Loutre Valley Lake Recreational Association, c/o Mrs. Joe Foster, President, 2829 Sugar Tree Lane, Marilyn Heights, Mo. 63043.
- f. Purpose of Dam. The dam impounds a recreational lake covering about 17 acres.
- g. Design and Construction History. It was reported by Mr. Plumer, Association member, that the dam was constructed in or about 1968.
- h. Normal Operating Procedure. There are no operating facilities for this dam.

1.3 PERTINENT DATA

- a. Drainage Area. 358 acres (0.56 square miles).
- b. Discharge at Damsite.
 - (1) All discharges at the damsite are through a 24 inch steel pipe principal spillway and an uncontrolled earthen emergency spillway.
 - (2) Estimated maximum flood at damsite -- unknown.

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 592.0 feet to 30 c.f.s. at the crest of the emergency spillway (elevation 596.0 feet) to 37 c.f.s. at the minimum top of dam (elevation 598.0 feet).

(4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 596.0 feet to 360 c.f.s. at elevation 598.0 feet (minimum top of dam).

(5) Total spillway capacity at the minimum top of dam is 397 c.f.s. ±.

c. Elevations (feet above M.S.L.).

- (1) Top of dam - 598.0 ± (Low point)
- (2) Principal spillway crest - 592.0 ±
- (3) Emergency spillway crest - 596.0 ±
- (4) Streambed at centerline - 562 ±
- (5) Maximum tailwater - unknown

d. Reservoir. Length (feet) of maximum pool - 1300 ±.

e. Storage (Acre-feet).

- (1) Top of dam - 290 ±
- (2) Principal spillway crest - 150 ±

f. Reservoir Surface (Acres).

- (1) Top of dam - 27 ±
- (2) Principal spillway crest - 17 ±

g. Dam.

- (1) Type - Earth fill
- (2) Length - 620 feet ±
- (3) Height - 36 feet ±
- (4) Top width - 12 feet ±
- (5) Side slopes
 - (a) Downstream - 2.3H on 1V (measured)
 - (b) Upstream - 2.5 H on 1V (measured)
- (6) Zoning - Unknown
- (7) Impervious core - Unknown
- (8) Cutoff - Unknown
- (9) Grout curtain - Unknown
- (10) Wave protection - none
- (11) Internal drainage system - Unknown

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

- (a) Type - Uncontrolled drop inlet, 24-inch diameter steel pipe riser with antivortex plate and 24-inch steel pipe conduit through the embankment.
- (b) Crest elevation - 592.0 feet
Outlet (invert) - 563.6 feet ±.
- (c) Length - 130 feet ±.

(2) Emergency

- (a) Type - Uncontrolled vegetated earth with bottom width of 45 feet ± and side slopes of 2.5H ± to 1V.
- (b) Control section - Level section approximately 25 feet in length.
- (c) Crest elevation - 596 feet ±.
- (d) Upstream Channel - Open vegetated channel with a slope at 3.8%±.

j. Regulating Outlets - A 10-inch steel drawdown pipe enters the upstream base of the riser. Invert of drawdown pipe is at elevation 584.2 ft. The control valve is located just upstream from the principal spillway riser (see Photo No. 7).

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Mr. Plumer that the dam was built in or about 1968.

2.3 OPERATION

No data were available on spillway operation. It was reported by Mr. Plumer that the emergency spillway has not operated.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General A visual inspection of the Loutre Valley Dam was made on June 27, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were: R. S. Decker, Geotechnical, Gordon Jamison, Hydrology; Garold Ulmer, Civil Engineer. Mr. Plumer, Association member and resident at the lake, accompanied the inspection team.
- b. Dam.
 - (1) Geology and Soils (abutment and embankment). The uplands in the area appear to be mantled with a thin cover of loess and/or glacial till. Soils on the slopes (abutments) appear to be residual derived from limestone and/or shale (probably Gasconade Series). Limestone, probably Fernvale of the Ordovician age, outcrops on the left abutment. Soils overlying limestone in the left abutment are very plastic red-yellow clays (CH). Materials exposed in the right abutment are cherty clay (CL-CH). No slides or slumps were observed in the abutments. Some silty clay shales (probably Maquoketa formation) were observed in the general area.

Foundation materials consist of CL-CH alluvium of unknown depth underlain by limestone or shale.
 - (2) Upstream Slope. The upstream slope is well vegetated with adapted grasses. A berm 10 feet in width is located at principal spillway elevation (592 feet). The upstream face of the berm had initially eroded to a near vertical face about 1 foot in height. However, the eroded face of the berm is now well stabilized with tullies and other phreatophytes (water loving plants). No erosion, rodent holes, cracks or deformations were noted on the upstream face. The entire slope had been recently mowed.
 - (3) Crest. The crest is well vegetated with grasses. The profile along the centerline is fairly uniform with less than 0.8 foot variation in elevation except on the right end which is about 1.6 foot higher than the central area. The crest of the dam is cambered from upstream to downstream. No rodent holes or deformations were noted on the crest. A few drying cracks were observed which would be normal for the CH materials found in the dam.

- (4) Downstream Slope. The downstream slope is very well vegetated with grass and sweet clover. A few large trees are growing at the toe of the right end of the dam (probably intentionally saved during construction). A few small trees and shrubs are growing in the left abutment trough and along the toe. No rodent holes or deformations were noted on the slope or along the toe. CH materials in the left abutment trough showed considerable cracking from desiccation. Borings on the slope indicate gray to gray brown CH material to a depth of 2 feet. No indication of any seepage was observed on the slope, in the abutment troughs, nor along the toe of the dam.
- (5) Miscellaneous. The vegetative cover and materials in the dam would indicate that it could withstand significant overtopping without serious damage.

c. Appurtenant Structures.

- (1) The principal spillway is open and appears to be in good shape with no deterioration noted in the riser or outlet pipe. There is no trash rack over the riser top which could result in reduced efficiency of spillway operation. The reservoir level was about 4 inches below the riser crest when inspected.
- (2) The emergency spillway is sparsely vegetated due undoubtedly to the gravelly nature of the surface materials. A considerable amount of chert and limestone gravel and small cobble is exposed in the spillway bottom. These materials prevented hand boring in the spillway, but it is expected that limestone bedrock is not far below the surface. No cracks, slumps or erosion were noted in the spillway. There was no indication that it had ever operated. Discharges from the spillway would exit well below the toe of the dam and should cause no damage to the structure.
- (3) Drawdown Facilities. A 10 inch steel drawdown pipe enters the base of the riser. This is controlled by a valve located just upstream from the principal spillway riser (see Photo No. 7). The drawdown facility is operable. It was reported by Mr. Plumer that the reservoir was lowered about 7 feet during the last two winters in order to rid the lake of moss and algae.

d. Reservoir Area. No slumps, slides, significant erosion or wave wash were noted around the shore line.

- e. Downstream Channel. The channel downstream from the pipe spillway is fairly open with a few small trees along the channel. The scour hole for the spillway is well armored with limestone gravel and small cobbles and appears to be stable as does the creek channel below.

3.2 EVALUATION

This structure appears to be in excellent condition with very little potential of failure (even from overtopping). The few minor deficiencies in maintenance such as tree growth on the downstream slope and the lack of a trash rack on the pipe spillway could ultimately cause some problems, but they should be easily remedied and are not considered serious.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam other than a 10" steel, valve operated drawdown pipe. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

Maintenance is generally good. The few small trees in the left abutment trough and along the toe of the left end of the dam should be removed.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There does not appear to be any serious potential of failure of this structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for this dam.
- b. Experience. There are no available records of reservoir operation. It was reported by Mr. Plumer that the emergency spillway has never operated.
- c. Visual Observations.
 - (1) The 24 inch steel pipe principal spillway is in good condition.
 - (2) The earthen emergency spillway is sparsely vegetated with some gravel and cherty clay covering the surface. Discharge from the emergency spillway will not endanger the dam.
- d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping of the dam. The spillways will pass the 100-year storm and 20% of the probable maximum flood without overtopping of the dam. The dam should withstand significant overtopping without serious damage.

<u>Frequency</u>	Peak Inflow Discharge c.f.s.	Peak Outflow Discharge c.f.s.	Maximum Pool Elevation	Freeboard Top of Dam Min. Elev. 598.0	Duration Of Dam Overtopping Hr.
100 Yr.	1,290	50	596.2	+1.8	0
1/2 PMF	3,060	2,480	599.4	-1.4	4+
PMF	6,110	*5,440	600.2	-2.2	6+
0.20 PMF	1,220	270	597.5	+0.5	0

*(Spillway discharge = 1,340 c.f.s.; Top-of-dam discharge = 4,100 c.f.s.)

The drainage area and elevation-storage data for the Loutre Valley Dam watershed were determined from the U.S.G.S. Americus, Missouri, $7\frac{1}{2}$ minute topographic quadrangle map. The hydraulic computations for the spillways and dam overtopping were based on data collected during the field inspection. Hydrologic and hydraulic computations are described in Appendix D.

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, the 1/2 PMF to PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. The dam appears to be structurally stable. The embankment materials and side slopes should provide adequate safety against shear failure. Analyses in Section 5 indicate that the dam would be overtopped 1.4 feet for about 4 hours by one half the Probable Maximum Flood. It would appear that such overtopping would not adversely affect the structural stability of the dam.
- b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Operating Records. There are no controlled operating facilities for this dam. It was reported by Mr. Plumer that the reservoir level has been drawn down about 7 feet during the winter months of 1977 and 1978 in order to control the growth of algae and moss in the lake.
- d. Post Construction Changes. The inspection team is not aware of any post construction changes for this structure.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

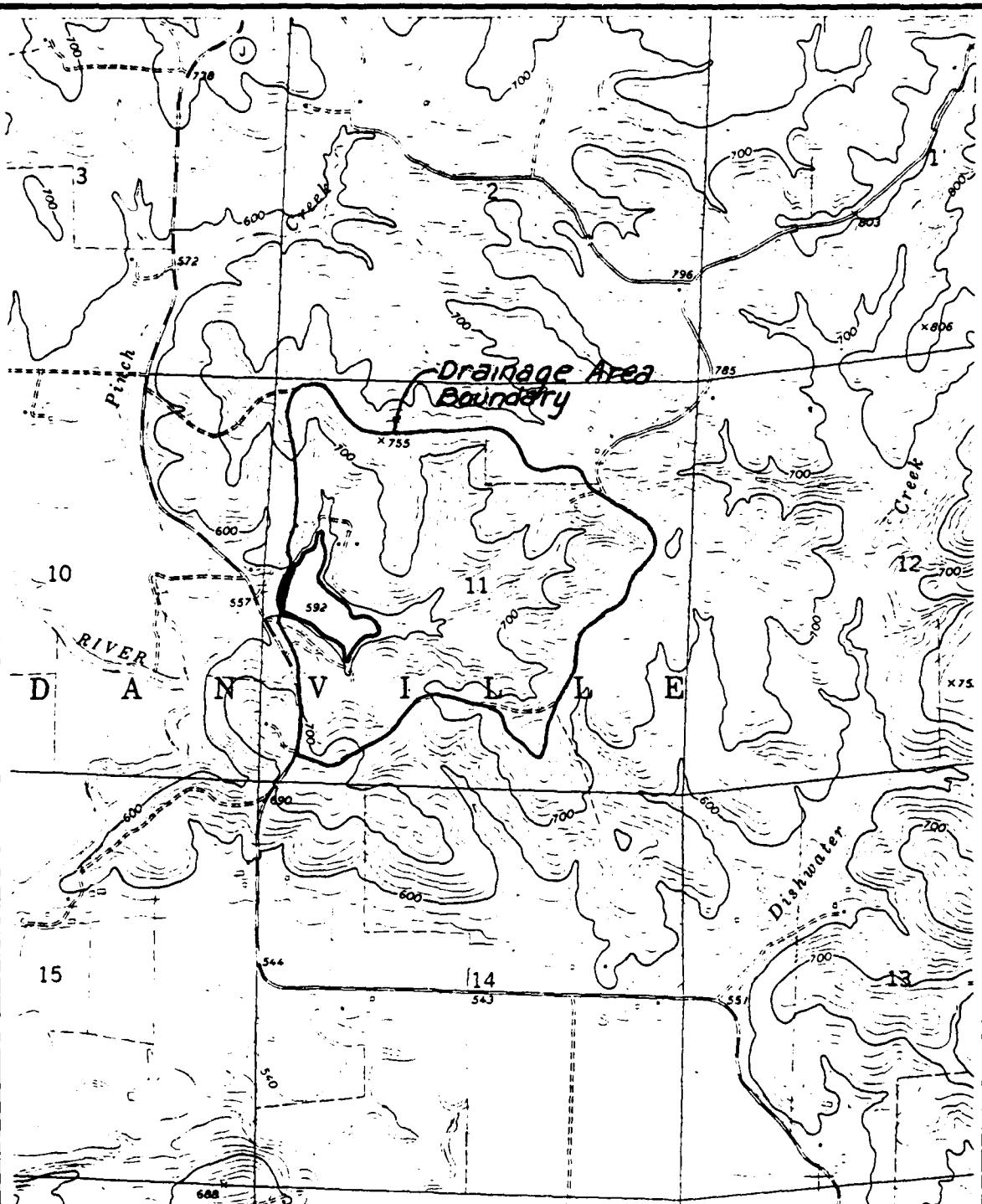
7.1 DAM ASSESSMENT

- a. Safety. This structure appears to be in excellent condition with little potential of failure. Additional studies would be required to determine the effects of overtopping on structural and erosional stability. It is felt however, that this structure could withstand significant overtopping without serious damage. Uncontrolled tree growth in the left abutment trough might ultimately impair the stability of the embankment. The lack of seepage and stability analyses is considered a deficiency.
- b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the guidelines were not available which is considered a deficiency.
- c. Urgency. The items recommended in paragraph 7.2a should be pursued without undo-delay.
- d. Necessity for Phase II. Phase II investigation is not considered necessary.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

- a. Alternatives. Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the height of dam or the size of the spillway that is necessary to pass one half the Probable Maximum Flood without overtopping the dam. The services of an engineer experienced in the design and construction of dams should be obtained to evaluate the present reservoir storage capacity, to provide seepage and stability analyses of the present dam, and to design protective measures, if required.
- b. O & M Procedures.
 - (1) Present maintenance procedures are generally good. The trees should be removed from the left abutment trough and measures taken to prevent their recurrence.
 - (2) Installation of a trash rack on the principal spillway inlet would assure efficient operation of the spillway.

APPENDIX A
MAPS



Scale in feet
2000 1000 0 2000 4000
Contour Interval - 20'

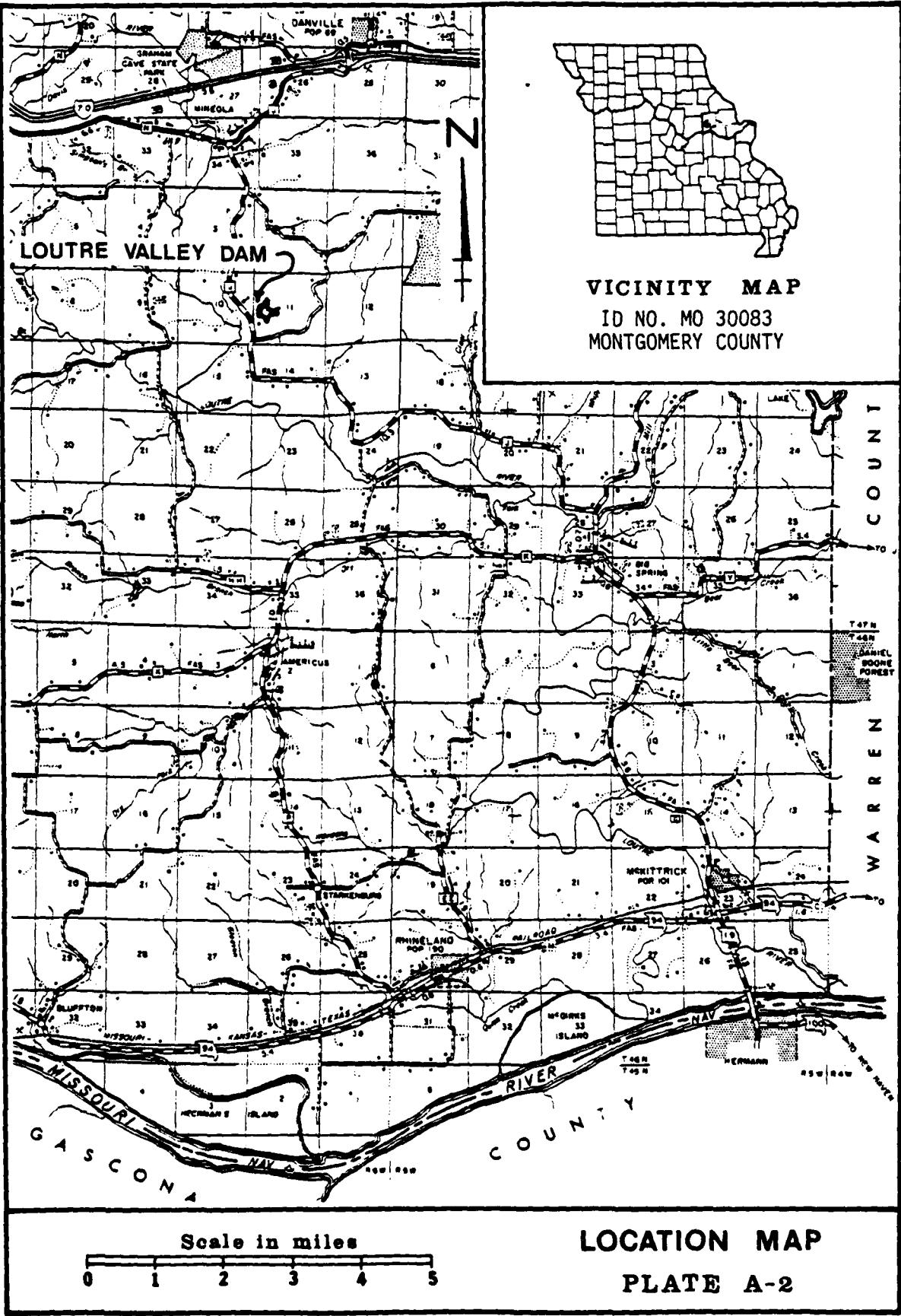


VICINITY TOPOGRAPHY LOUTRE VALLEY DAM

MONTGOMERY COUNTY, MO.

MO. 30083

PLATE A-1



APPENDIX B
PHOTOGRAPHS

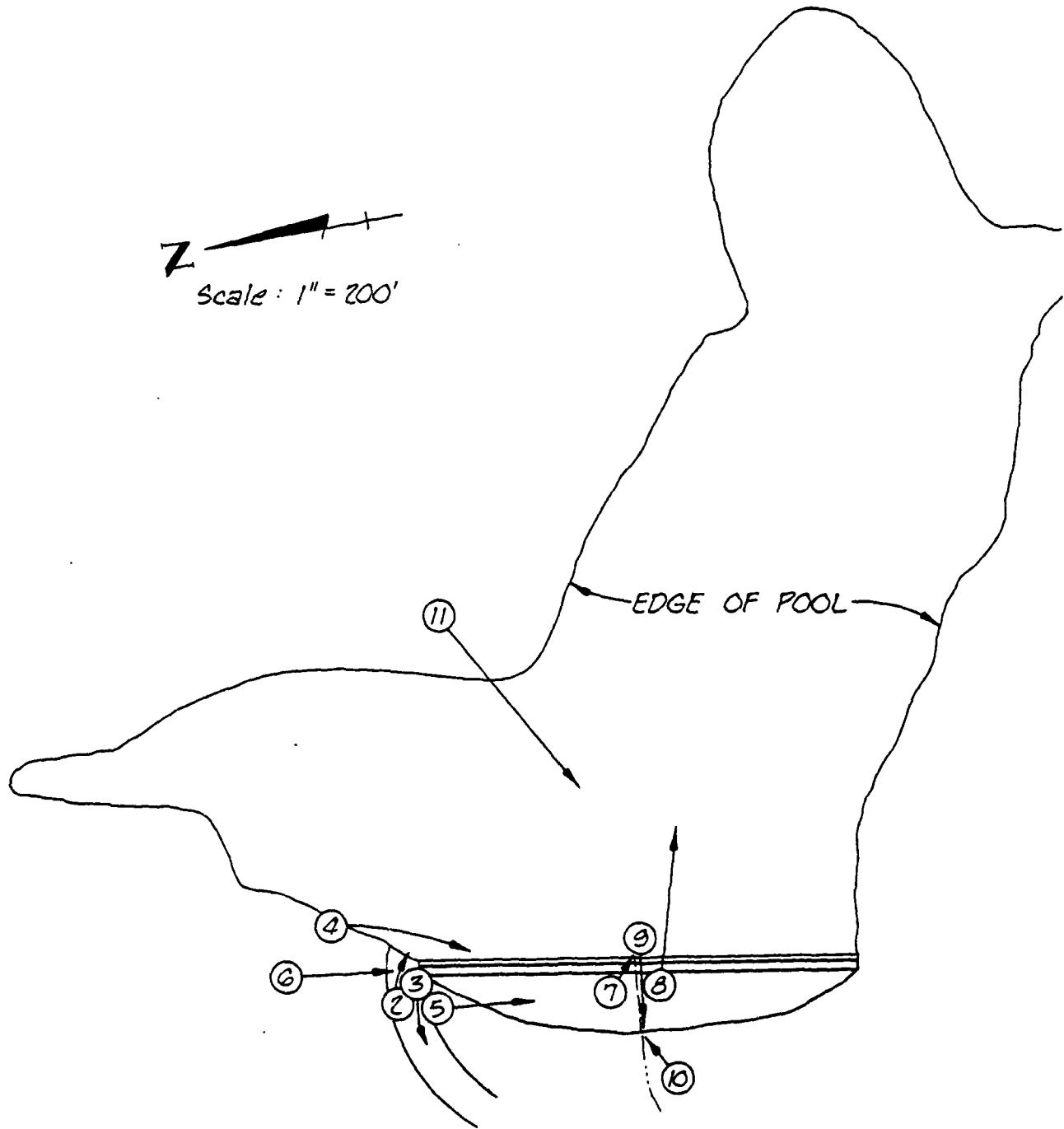


PHOTO INDEX

LOUTRE VALLEY DAM

MONTGOMERY COUNTY, MISSOURI

MO. 30083

PLATE B-1



PHOTO NO. 2 VIEW LOOKING UPSTREAM IN EMERGENCY SPILLWAY.



PHOTO NO. 3 VIEW LOOKING DOWNSTREAM IN EMERGENCY SPILLWAY.

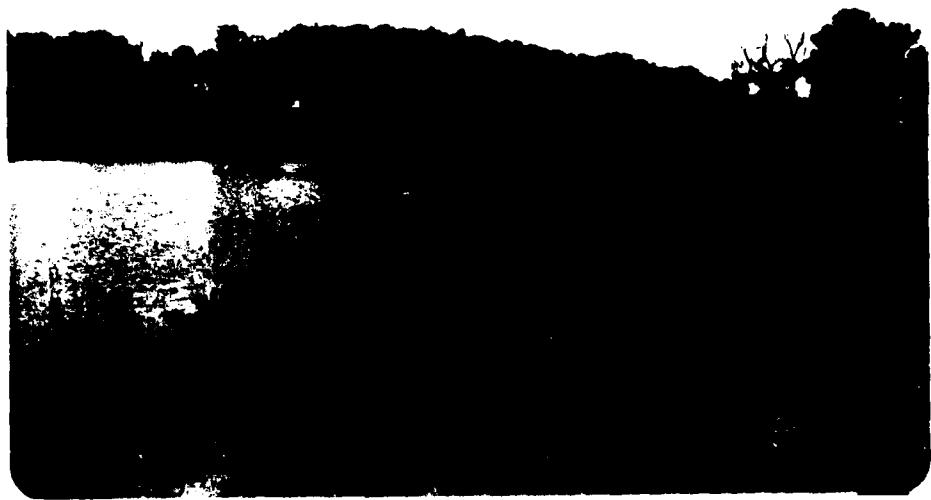


PHOTO NO. 4 VIEW OF UPSTREAM SLOPE FROM RIGHT ABUTMENT



PHOTO NO. 5 VIEW OF DOWNSTREAM SLOPE FROM RIGHT END.



PHOTO NO. 6 CREST TAKEN FROM RIGHT ABUTMENT.



PHOTO NO. 7 PRINCIPAL SPILLWAY RISER

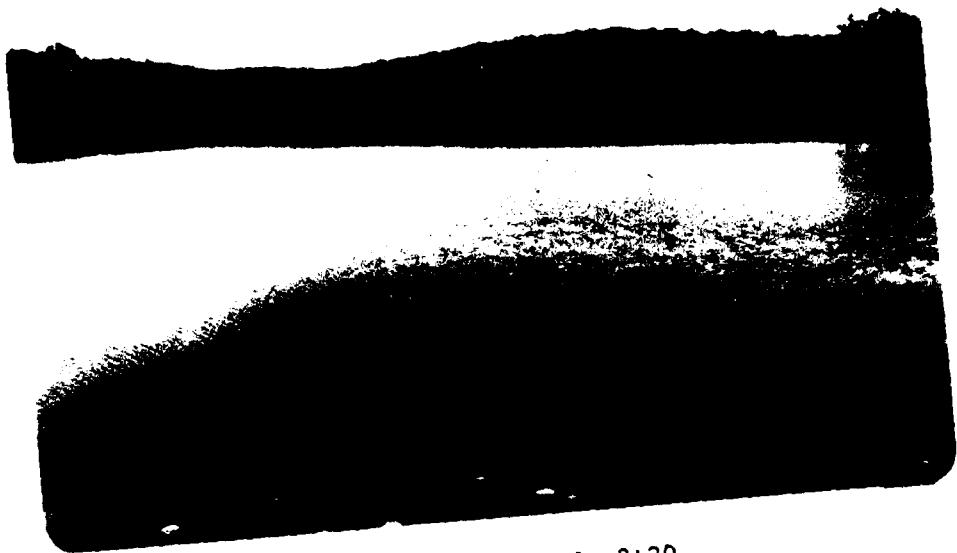


PHOTO NO. 8 VIEW UPSTREAM FROM STA. 3+30.

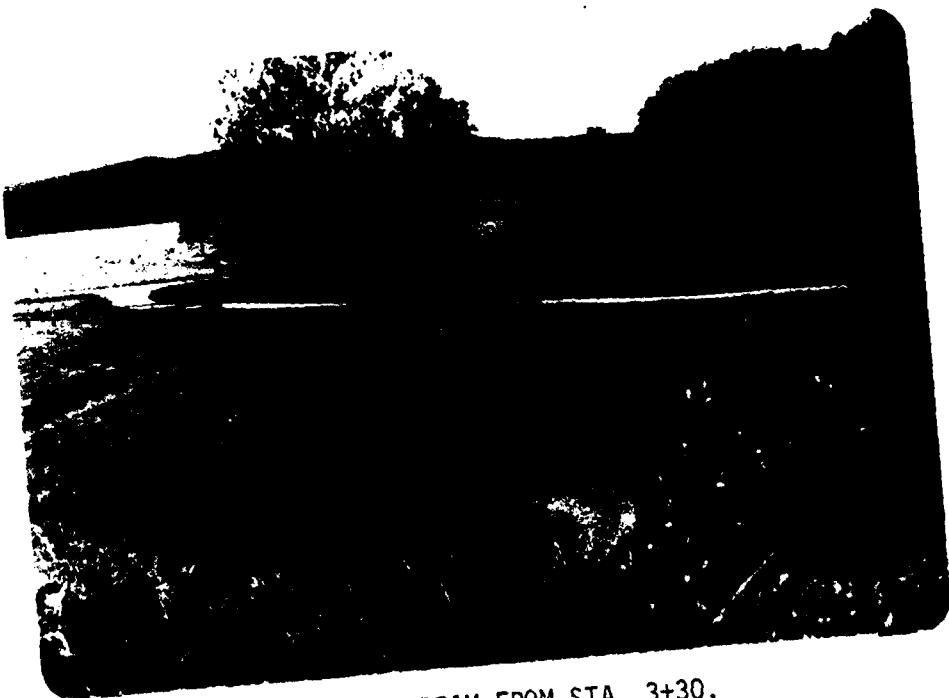


PHOTO NO. 9 VIEW DOWNSTREAM FROM STA. 3+30.

PLATE B-5



PHOTO NO. 10 OUTLET END OF PRINCIPAL SPILLWAY



PHOTO NO. 11 OVERVIEW TAKEN FROM UPSTREAM ON RIGHT SIDE.

APPENDIX C
PROJECT PLATES

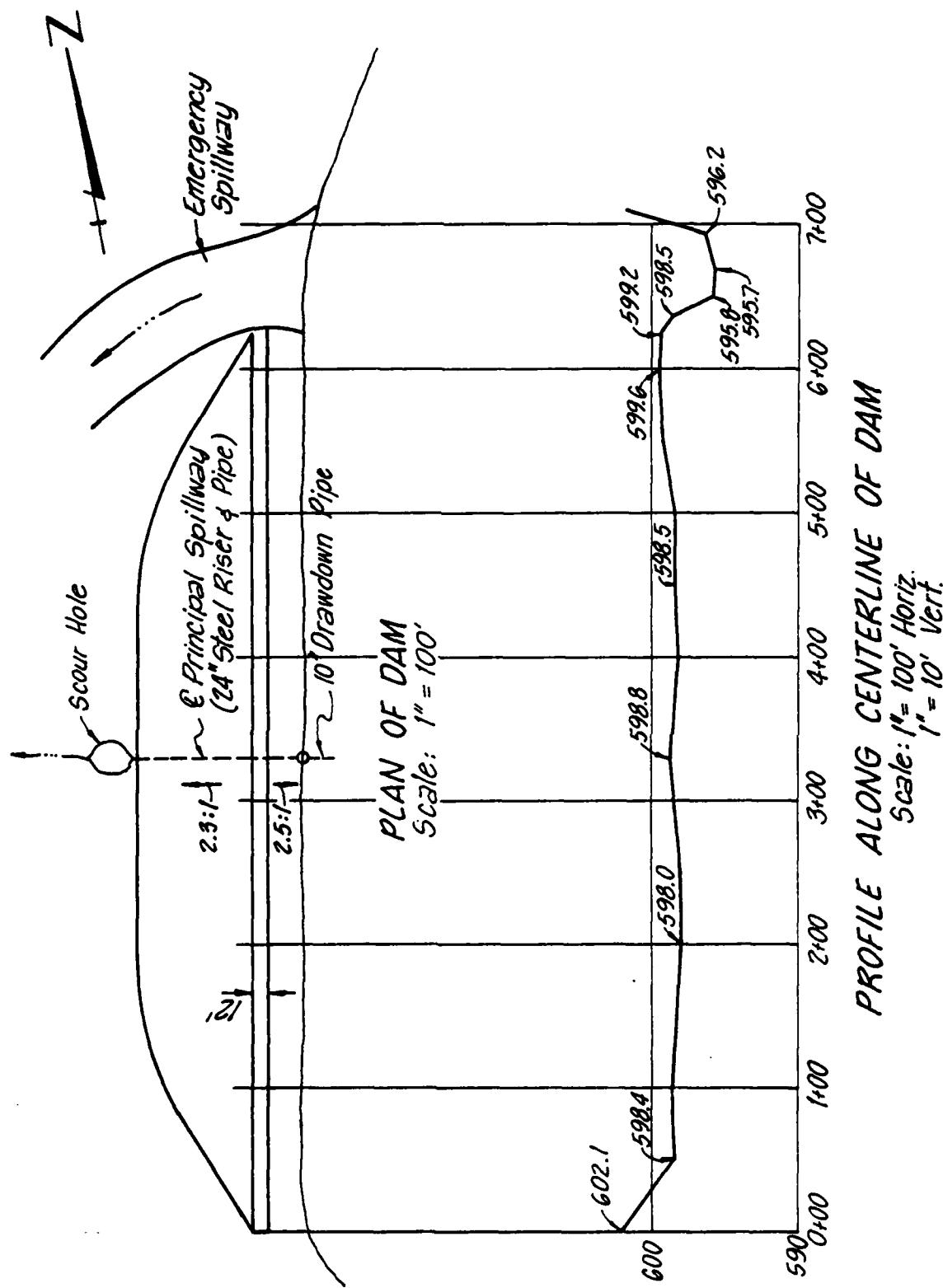
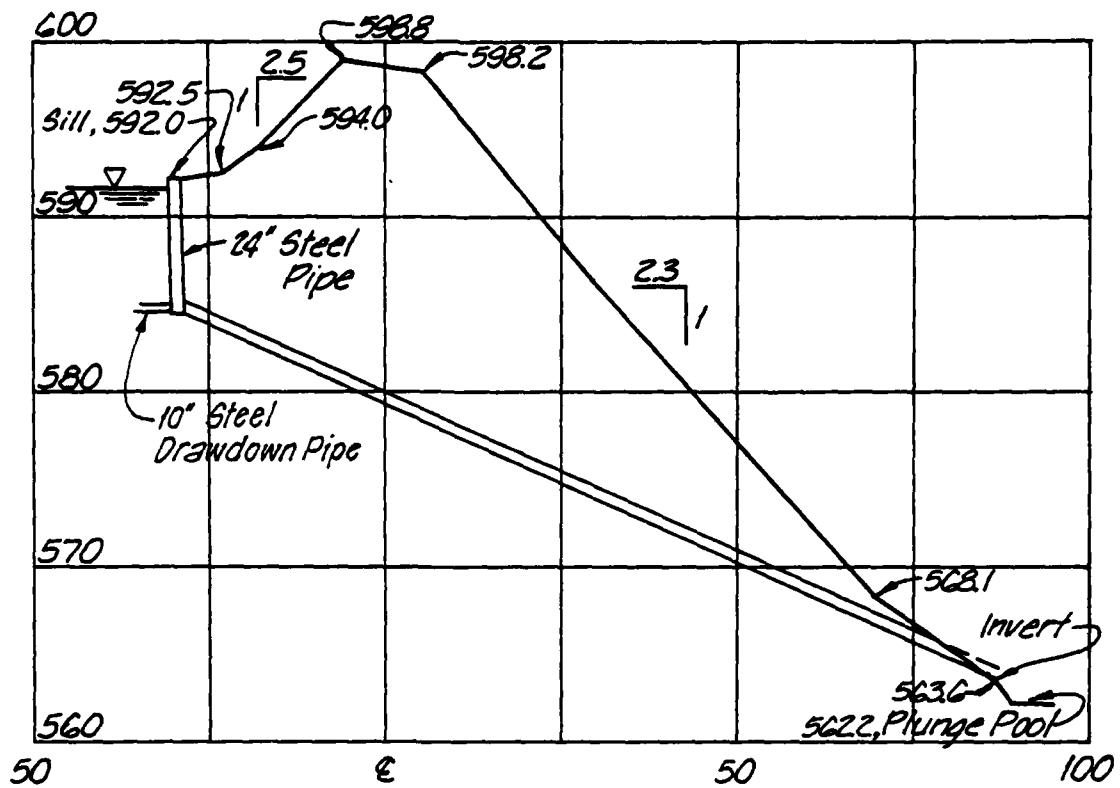
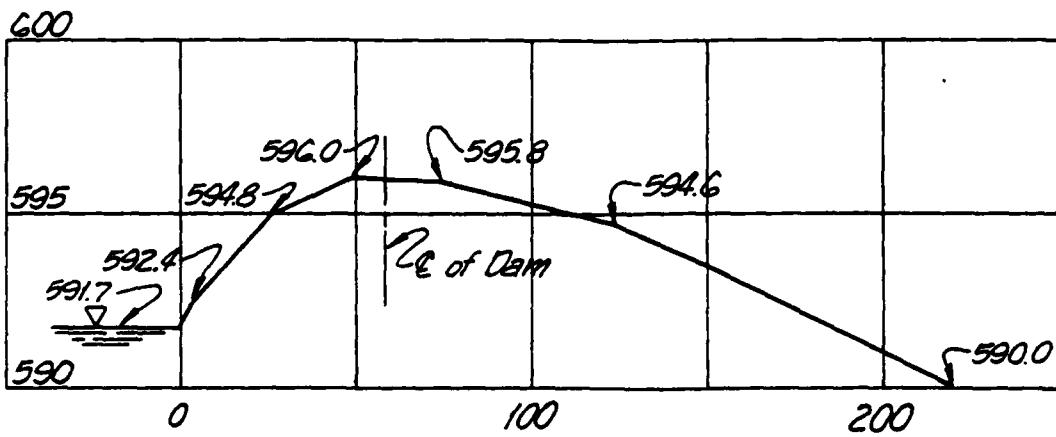


PLATE C-1



DAM SECTION @ STA. 3+30

Scale: 1" = 25' H.
1" = 10' V.



E EMERGENCY SPILLWAY PROFILE

Scale: 1" = 50' H.
1" = 5' V.

PLATE C-2

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

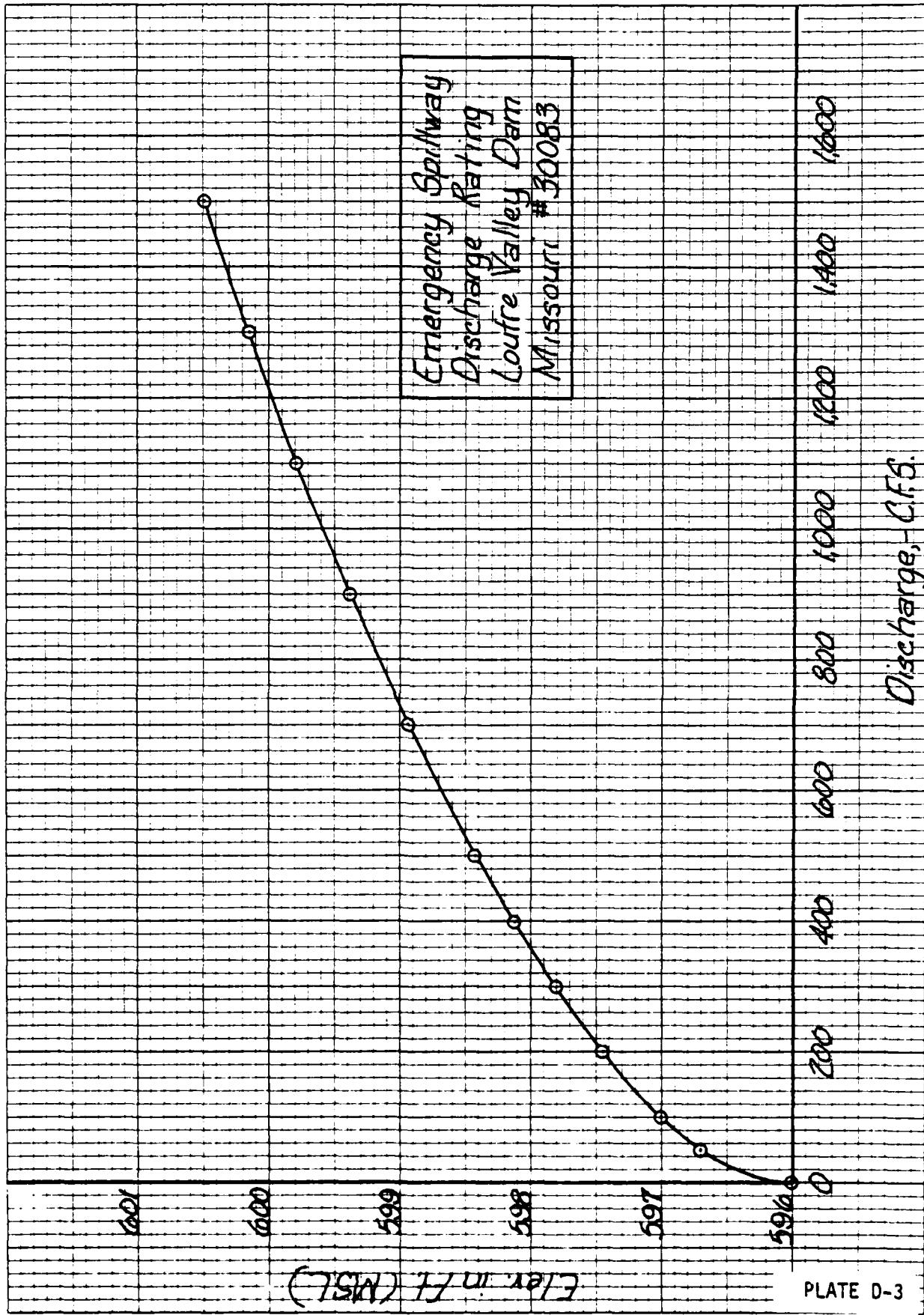
1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs.
 - a. Twenty-four hour, 100-year rainfall for the dam location was taken from the data for the rainfall station at Sullivan, Missouri, as supplied by the St. Louis District, Corps of Engineers per their letter dated March 6, 1979. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.
 - b. Drainage area = 0.56 square miles (358 acres).
 - c. Time of concentration of runoff = 21 minutes (computed from "Kirpich" formula).
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the principal spillway crest.
 - e. The total twenty-four hour storm duration losses for the 100-year storm were 3.31 inches. The total losses for the PMF storm were 1.88 inches. These data are based on SCS runoff curve No. 86 and No. 71 for antecedent moisture conditions, SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil group C and consists mostly of woodland.
 - f. Average soil loss rates = 0.08 inch per hour for the PMF.

2. The discharge rating for the spillway was developed using the Corps of Engineers Water Surface Profile HEC-2 computer program and dimensions measured in the field.

The discharge rating curve for the principal spillway was developed using the equation $Q=CLH^{3/2}$ for weir flow, the equation $Q=C_c A(2gH)^{1/2}$ for orifice flow and the Bernoulli energy equation for full flow.

The discharge rating curve for flow over the dam crest was developed using the HEC-1 (Dam Safety Version) program.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program. The input, output, and plotted hydrographs are included with this report in this Appendix.



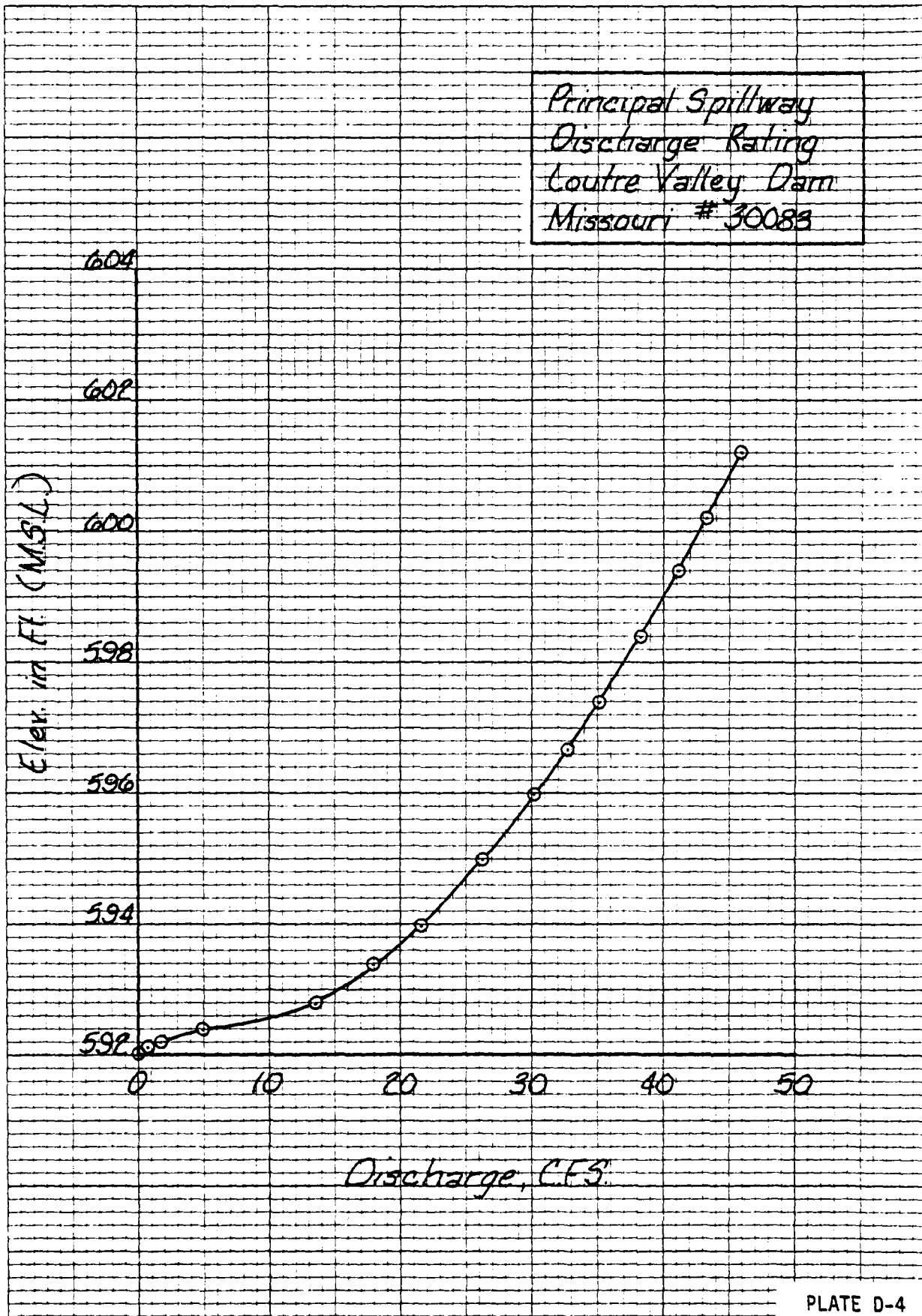
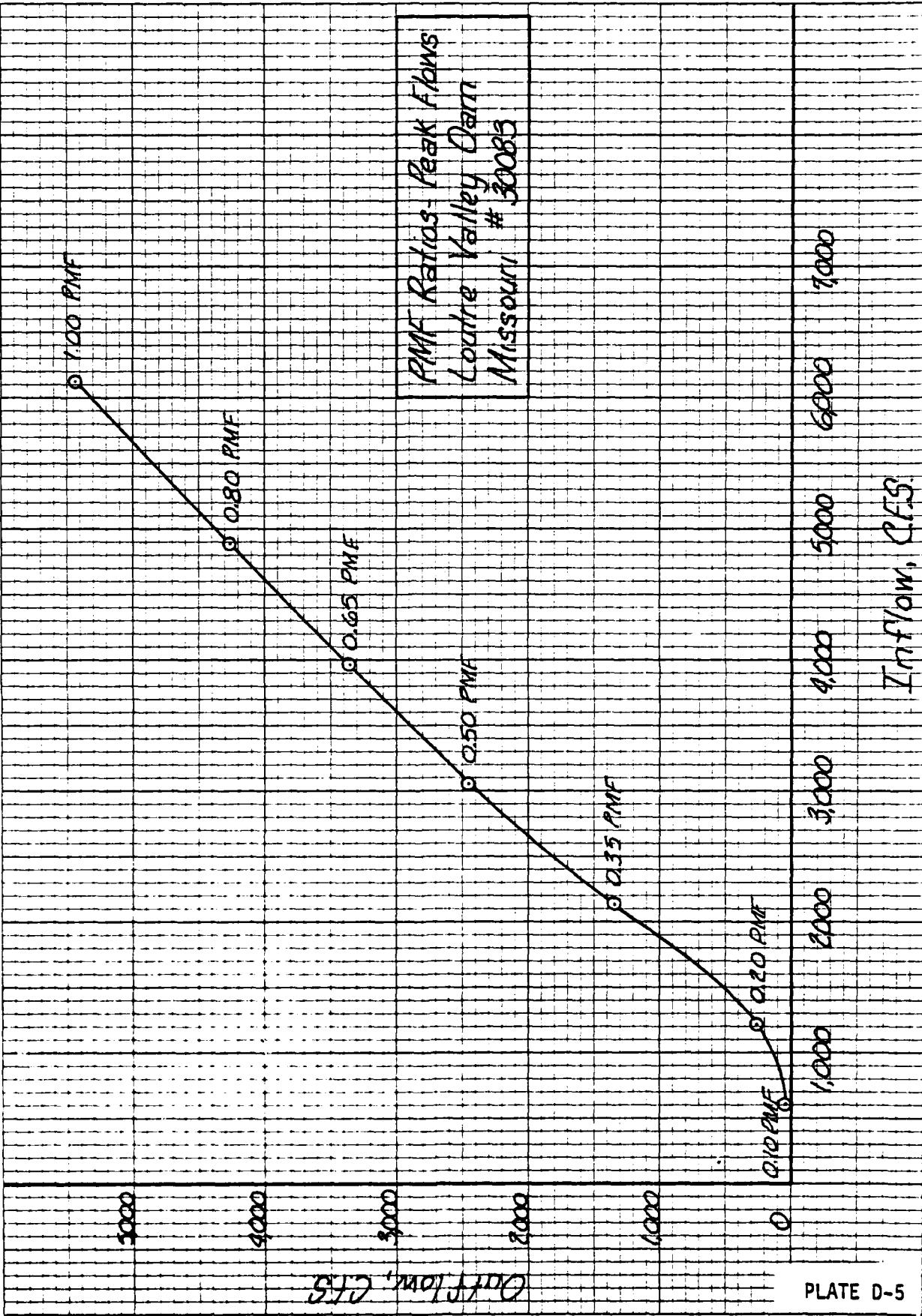


PLATE D-4



HYDROGRAPH AT STA000001 FOR PLAN 1, RTN 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6891.	1261.	368.	368.	105912.
CMS	138.	34.	10.	10.	3001.
INCHES		19.95	24.45	24.45	24.45
MM	506.72	621.00	621.00	621.00	621.00
AC-FT		596.	70.	730.	730.
THOUS CU M	735.	900.	900.	900.	900.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTN 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6116.	1501.	460.	460.	13245.
CMS	173.	43.	13.	13.	3151.
INCHES		24.94	30.56	30.56	30.56
MM	633.41	776.26	776.26	776.26	776.26
AC-FT		744.	92.	912.	912.
THOUS CU M	918.	1125.	1125.	1125.	1125.

HYDROGRAPH ROUTING

RESERVOIR ROUTING OF HYDROGRAPH AT LOUETRE VALLEY DAM

1STAQ	ICOMP	ICOND	ITAPE	JPLT	JPT	I NAME	I STAGE	I AUTO
0000002	1	0	0	2	0	1	0	0
			ROUTING DATA					
QLOSS	CLOSS	Avg	IRRES	I NAME	I OPT	IPMP	LSTA	
0.0	0.00	0.00	1	1	0	0	0	
NSTPS	NSTOL	LAG	ANSKK	X	TSK	STORA	ISPRAT	
1	0	0	0.000	0.000	0.000	-592.	-1	
STAGE	592.00	592.20	592.40	592.80	593.40	594.00	595.00	596.00
FLOA	591.40	591.80	598.10	598.40	598.90	599.40	599.90	601.20
C.CD	235.00	336.00	431.00	536.00	740.00	941.00	1142.00	1343.00
ELEVATION	565.	592.	600.	620.				
SURFACE AREA	C.	17.	31.	59.				
CAPACITY	0.	150.	337.	1216.				
CREST LENGTH	10.	55.	70.	725.				
AT CR ELEV								
DAM DATA								
ICPTL	CGCC	EXPO	DAMNID					
565.0	3.0	1.5	0.					

PLATE D-8

ELIMINACION 446-0 498-1 598-2 598-3 598-4 598-5 598-6 599-3 599-6 602-1

STATISTICAL METHODS IN MEDICAL RESEARCH 1

SALVATION FROM ILLNESS

SEVEN HUNDRED EIGHTY-ONE

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•CVN

STATION 000002, PLAN 1, RATIO 4 (0.50 PMF)
END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW													
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
3.	4.	4.	5.	5.	6.	6.	7.	7.	7.	8.	9.	10.	10.
11.	12.	12.	13.	13.	14.	14.	15.	15.	15.	15.	15.	15.	15.
16.	16.	16.	16.	16.	17.	17.	17.	17.	17.	18.	18.	18.	18.
18.	18.	18.	18.	18.	19.	19.	19.	19.	19.	19.	20.	20.	20.
20.	20.	20.	20.	20.	21.	21.	21.	21.	21.	21.	22.	22.	22.
22.	22.	22.	22.	22.	23.	23.	23.	23.	23.	23.	24.	24.	24.
26.	26.	26.	26.	26.	26.	26.	25.	25.	25.	26.	26.	27.	27.
27.	28.	28.	28.	29.	29.	29.	30.	30.	32.	42.	53.	64.	64.
74.	85.	100.	116.	116.	136.	163.	168.	211.	233.	255.	255.	255.	255.
276.	299.	321.	345.	345.	372.	397.	421.	445.	469.	492.	492.	492.	492.
514.	532.	561.	568.	607.	693.	914.	1395.	2027.	2446.	2446.	2446.	2446.	2446.
2476.	2263.	1936.	1638.	1388.	1192.	1046.	864.	809.	809.	809.	809.	809.	809.
768.	737.	715.	698.	684.	671.	654.	635.	616.	599.	599.	599.	599.	599.
585.	574.	564.	555.	548.	542.	535.	522.	499.	499.	499.	499.	499.	499.
437.	408.	380.	354.	330.	312.	295.	279.	264.	249.	249.	249.	249.	249.
236.	223.	211.	200.	189.	179.	170.	162.	154.	146.	146.	146.	146.	146.
139.	133.	129.	126.	122.	119.	116.	113.	110.	107.	107.	107.	107.	107.
104.	102.	99.	97.	94.	92.	90.	88.	87.	86.	86.	86.	86.	86.
85.	86.	83.	82.	81.	80.	79.	78.	77.	77.	77.	77.	77.	77.
76.	75.	74.	73.	72.	72.	71.	70.	70.	70.	70.	70.	70.	70.
68.	67.	67.	66.	66.	65.	64.	64.	64.	64.	64.	64.	64.	64.
STORAGE													
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.
151.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.	151.
151.	151.	152.	152.	152.	152.	152.	152.	152.	152.	152.	152.	152.	152.
152.	152.	152.	152.	152.	153.	153.	153.	153.	153.	154.	154.	154.	154.
156.	156.	156.	157.	157.	158.	158.	159.	160.	160.	160.	160.	160.	160.
162.	162.	163.	164.	164.	165.	165.	166.	166.	166.	167.	167.	167.	167.
168.	169.	170.	170.	171.	171.	172.	172.	173.	173.	174.	174.	174.	174.
176.	176.	176.	176.	176.	176.	176.	176.	180.	181.	181.	181.	181.	181.
183.	184.	184.	185.	185.	186.	187.	187.	188.	188.	189.	189.	189.	189.
190.	191.	192.	193.	194.	194.	195.	195.	196.	196.	197.	197.	197.	197.
198.	199.	200.	200.	201.	201.	204.	204.	206.	206.	208.	208.	208.	208.
213.	216.	219.	222.	222.	225.	227.	230.	233.	233.	236.	236.	236.	236.
242.	245.	248.	251.	254.	257.	259.	262.	264.	264.	266.	266.	266.	266.
268.	271.	273.	275.	277.	279.	281.	283.	284.	284.	286.	286.	286.	286.
288.	288.	289.	290.	291.	291.	290.	290.	290.	290.	291.	291.	291.	291.
319.	317.	313.	309.	306.	303.	301.	299.	297.	297.	296.	296.	296.	296.
295.	295.	294.	294.	293.	293.	293.	292.	292.	292.	291.	291.	291.	291.
290.	290.	289.	286.	286.	286.	286.	287.	287.	287.	286.	286.	286.	286.
282.	280.	278.	276.	276.	274.	274.	272.	272.	272.	269.	269.	269.	269.
264.	263.	262.	260.	260.	259.	259.	258.	258.	258.	257.	257.	257.	257.

PLATE D-10

PEAK OUTFLOW IS 2476. AT TIME 15.92 HOURS

PLATE D-11

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STATION 000002

INFLOW (LITERS)		OUTFLOW (LITERS)	AD OBSERVED FLOW (LITERS)
0.	400.	600.	1,200.

-PLATE D-12

4.45	571
4.50	581
4.55	591
5.00	601
5.10	621
5.15	631
5.20	641
5.25	651
5.30	661
5.35	671
5.40	681
5.45	691
5.50	701
5.55	711
6.00	721
6.05	731
6.10	7401
6.15	7501
6.20	76C1
6.25	770
6.30	78C
6.35	790
6.40	80C
6.45	810
6.50	82C
6.55	830
7.00	840
7.05	850
7.10	86C
7.15	870
7.20	880
7.25	89C
7.30	900
7.35	910
7.40	92C
7.45	930
7.50	940
7.55	950
8.00	96C
8.05	970
8.10	980
8.15	99C
8.20	1000
8.25	1010
8.30	102C
8.35	1030
8.40	1040
8.45	1050
8.50	1060
9.15	1110
9.20	112C
9.25	1130
9.30	114C
9.35	1150
9.40	1160
9.45	1170
9.50	118C

PLATE D-13

5.59119C	1
10.001200.	0
10.03121.0	1
10.10122.5	1
10.13123.0	1
10.20124.0	1
10.23125.0	1
10.30126.0	1
10.39127.0	1
10.50128.C	1
10.45125.0	1
10.5013C.0	1
10.55131.0	1
11.00132.0	1
11.09133.0	1
11.10134.0	1
11.15135.0	1
11.20136.C	1
11.23137.0	1
11.30138.0	1
11.39139.0	1
11.50140.0	1
11.45141.0	1
11.50142.0	1
11.55143.0	1
12.00144.0	1
12.05145.0	1
12.10146.0	1
12.15147.0	1
12.20148.0	1
12.25149.0	1
12.30150.0	1
12.35151.0	1
12.40152.0	1
12.45153.0	1
12.50154.0	1
12.55155.0	1
13.00156.0	1
13.05157.0	1
13.10158.0	1
13.15159.0	1
13.20160.0	1
13.25161.0	1
13.30162.C	1
13.35163.0	1
13.40164.0	1
13.45165.0	1
13.50166.0	1
13.55167.0	1
14.00168.0	0
14.05169.0	0
14.10170.0	0
14.15171.0	0
14.20172.0	0
14.25173.0	0
14.30174.0	0
14.35175.0	0
14.40176.0	0
14.45177.0	0
14.50178.0	0
14.55179.0	0
15.00180.0	0

PLATE D-14

15.051.01.	0	1
15.101.02.	0	1
15.151.03.	0	1
15.201.04.	0	1
15.251.05.	0	1
15.301.06.	0	1
15.351.07.	0	1
15.401.08.	0	1
15.451.09.	0	1
15.501.10.	0	1
15.551.11.	0	1
15.601.12.	0	1
16.021.93.	1	0
16.101.94.	1	0
16.151.95.	1	0
16.201.96.	1	0
16.251.97.	1	0
16.301.98.	1	0
16.351.99.	1	0
16.402.00.	1	0
16.452.01.	1	0
16.502.02.	1	0
17.052.03.	0	1
17.102.04.	0	1
17.152.05.	0	1
17.202.06.	0	1
17.252.07.	0	1
17.302.08.	0	1
17.352.09.	0	1
17.402.10.	0	1
17.452.11.	0	1
17.502.12.	0	1
17.552.13.	0	1
17.602.14.	0	1
17.652.15.	0	1
18.002.16.	0	1
18.052.17.	0	1
18.102.18.	0	1
18.152.19.	0	1
18.202.20.	0	1
18.252.21.	0	1
18.302.22.	0	1
18.352.23.	0	1
18.402.24.	0	1
18.452.25.	0	1
18.502.26.	0	1
18.552.27.	0	1
19.002.28.	0	1
19.052.29.	0	1
19.102.30.	0	1
19.152.31.	0	1
19.202.32.	0	1
19.252.33.	0	1
19.302.34.	0	1
19.352.35.	0	1
19.402.36.	0	1
19.452.37.	0	1
19.502.38.	0	1
19.552.39.	0	1
20.002.40.	0	1
20.052.41.	0	1
20.102.42.	0	1

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PLATE D-15

PLATE D-16

PEAK FLOW AND STURGE LEND OF PERCOLATION SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
				.10	.20	.35	.50	.65	.80	1.00

HYDROGRAPH AT	0000001	.50	1	6111	1223	2160	3057	3974	4891	6114
	1	1.451	1	17.311	34.621	60.591	86.561	112.531	138.491	173.121
ACUTED TC	0000002	.56	1	25.	265.	1368.	2476.	3374	4261	5137.
	1	1.451	1	.8211	7.5211	38.7511	70.1111	95.5411	120.6611	153.9511

SUMMARY OF CAN SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION		\$92.00	\$92.00	\$92.00
STORAGE		150.	150.	280.
OUTFLOW		0.	0.	403.

RATIO OF RESERVOIR W. S. ELEV P.M.F.	MAXIMUM DEPTH OVER CAN	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	595.76	0.00	255.	29.	0.00	18.42
.20	598.52	0.00	267.	265.	0.00	16.67
.35	598.93	.53	306.	1368.	2.50	16.00
.50	599.33	1.39	319.	2476.	3.83	15.92
.65	599.68	1.66	326.	3374.	4.75	15.83
.80	599.93	1.93	335.	4261.	5.42	15.83
1.00	600.24	2.24	345.	5437.	6.00	15.83

PLATE D-18

